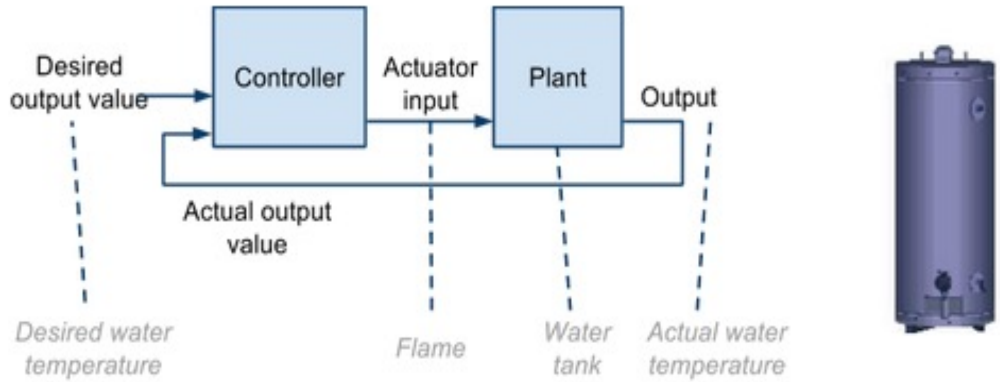
CSCE 4114 Embedded Systems

Ch 11. Control Systems

David Andrews
dandrews@uark.edu

Ch 11.1

Figure 11.1.1: Water heater control system.



desired-actual = error

Controller: use error to adjust actuator to drive error -> 0

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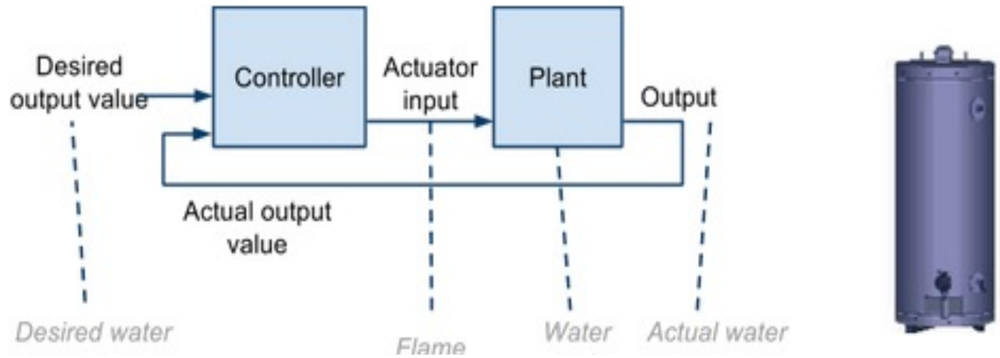
Figure 11.1.1: Water heater control system.



flame | plant | controller | error | actual water temperature

	Controls the heat of a burner depending on the water temperature error
	The difference between desired and actual water temperature
	A tank of water whose temperature is being controlled
	Actuator input that affects temperature of water heater
	Controlled by the water heater control system

Reset

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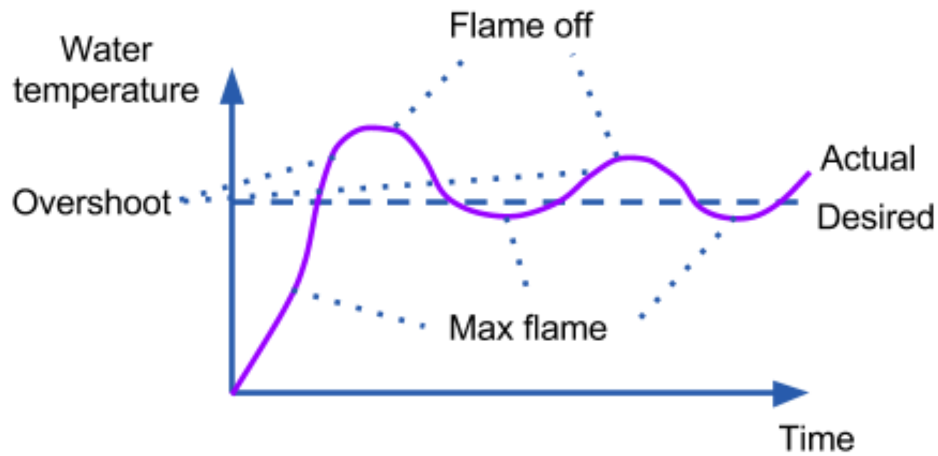
Figure 11.1.3: On/Off control behavior.



Controller: sets heater to on/off

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1) A control system regulates a physical property, like temperature or speed.
   - ○ True
   - ○ False

2) On-off control is a simple control mechanism that either completely enables or disable an actuator.
   - ○ True
   - ○ False

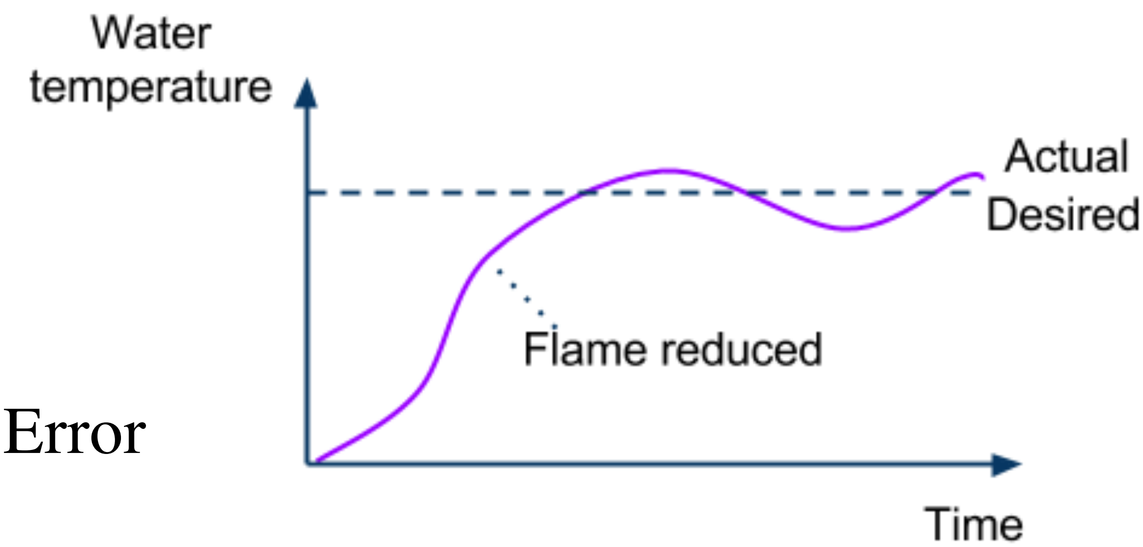
3) Overshoot occurs when the actual output value fails to reach the desired value.
   - ○ True
   - ○ False

4) Oscillation occurs when the actual value switches between being higher and lower than the desired value.
   - ○ True
   - ○ False

5) An unstable system will never match the actual output value to the desired output value.
   - ○ True
   - ○ False

Ch 11.2 Proportional control

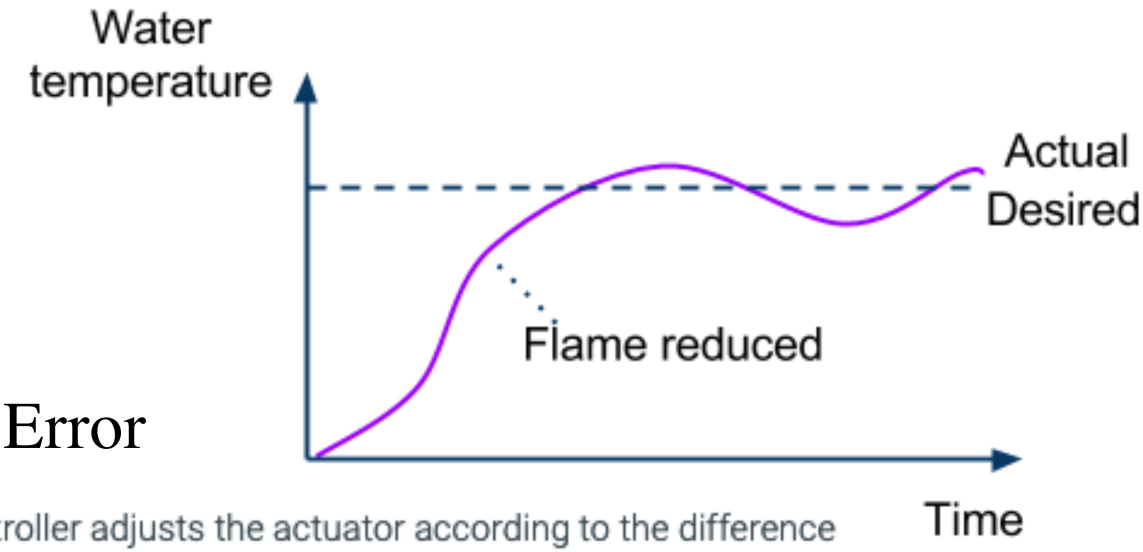
Figure 11.2.1: Proportional control plot.



Actuator = Kp*Error

Ch 11.2 Proportional control

Figure 11.2.1: Proportional control plot.



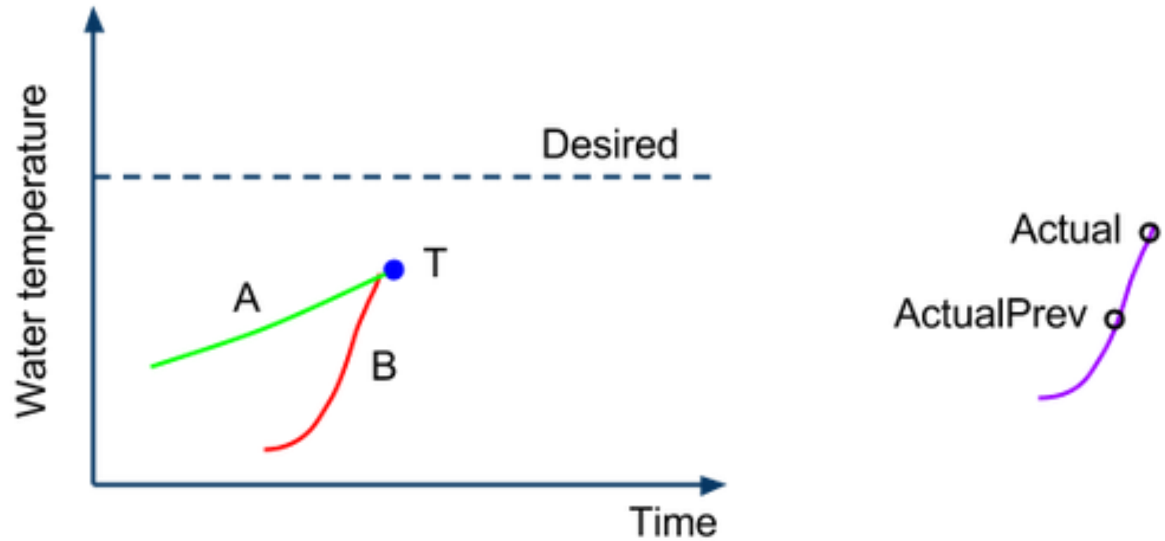
Actuator = Kp*Error

1) A proportional controller adjusts the actuator according to the difference between actual and desired system output.
   - True
   - False

2) Kp is a carefully-chosen constant.
   - True
   - False

Ch 11.3 Proportional-derivative control

Figure 11.3.1: PD graph.



Deriv = Actual –ActualPrev

Actuator = Kp*Error –Kd*Deriv

Ch 11.3 Proportional-derivative control

1) A PD controller considers both the output error and the output rate of chang

   - True
   - False

2) The slope of the output can be calculated with the equation Deriv = ActualPrev + Actual.

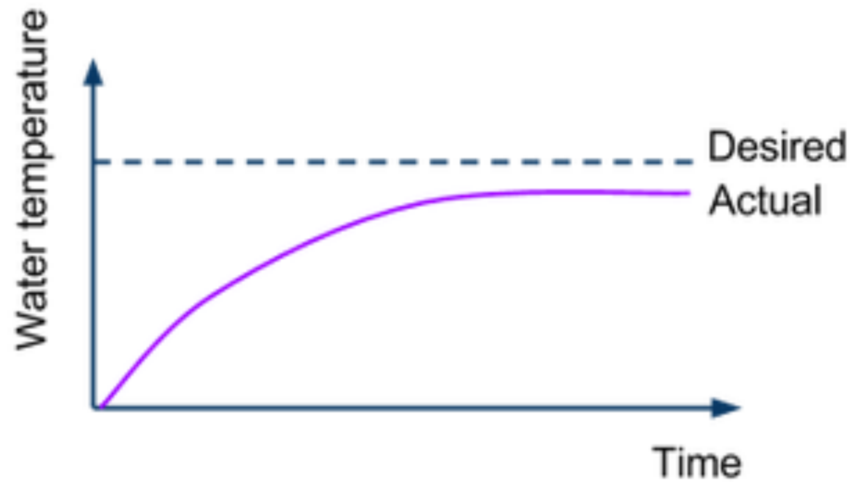
   - True
   - False

3) The following equation implements a PD controller: Actuator = Kp*Error + Kd*Deriv.

   - True
   - False

Ch 11.3
Proportional-integral- derivative control

Figure 11.4.1: Steady state error.

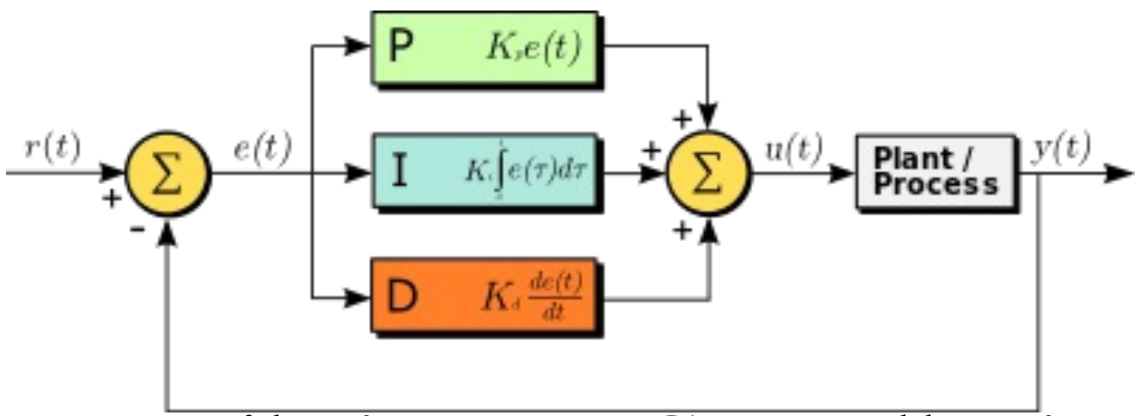


Ch 11.3
Proportional-integral- derivative control

Figure 11.4.2: Determining the integral term.

```
Integ = Integ + Error;
if (Integ > IntegMax) {
   Integ = IntegMax;
}
else if (Integ < IntegMin) {
   Integ = IntegMin;
}
```

Actuator = Kp*Error + Ki*integ – Kd*Deriv



Voila ! PID Controller !